THE IRP PROCESS: BEST PRACTICES

MEMPHIS LIGHT, GAS & WATER
POWER SUPPLY ADVISORY TEAM

Seth Brown
June 6, 2019
Integrated Resource Plans (IRPs) are effective road maps
- Identifies future deficiencies and potential resource
- Identifies types of resource deficiencies
- Provides guidance on criteria for future decisions
- Provide transparency and clear communication to all stakeholders about process and goals

Well-defined goals lead to well-defined power supply strategies
- Renewable Portfolio
- Ownership vs. Purchased Power
- Fuel Diversity
RESOURCE PLANNING OBJECTIVES

- Generation ownership
- Add more renewables
- Local generation/reliability
- Short term / Long term PPA’s
- Targeted market exposure
- Diversify energy supply
- Retail rates and competitive situation
GENERAL IRP SCOPE

- Load Forecast (20+yr)
  - Including sensitivities on economic and weather data
- Evaluate DSM / EE alternatives
- Review existing power supply resources
- Assess power supply alternatives
  - PPA opportunities, market alternatives, upgrades/retrofits, decommissioning, excess power, traditional thermal generation alternatives (solely or jointly owned), and renewables
RESOURCE SCREENING

- Economic feasibility
- Locational value
- Portfolio diversification
- Emissions regulations
- Ownership vs. PPA
- Renewables vs. traditional resources
- Transmission interconnection
- Fuel transportation / availability
- Financing implications
REQUIRED INFORMATION

- EPC / project capital cost
- Summer rated capacity
- Fixed O&M cost
- Variable O&M cost
- Heat rate curve
- Fuel cost & transportation
- Decommissioning cost
- Financing term
- Emission rates
- Inflation / escalation rates
- Discount rates
- Levelized fixed charge rate
- Availability / FO Rate
- Ancillary services
Transmission / Market Modeling via:
  - PROMOD IV
  - MarketPower
  - PSS/E
  - Crystal Ball
LONG-TERM POWER SUPPLY PLANNING GOALS

- **Resource Diversity**
  - Economic Feasibility
  - Portfolio “Fit”
  - Congestion Risk

- **Contract Term Diversity**
  - Start/end points
  - Layering approach

- **Fuel Diversity**
  - Source differentiation
  - Hedge to fuel prices
  - Environmental regulation

- **Renewable Diversity**
  - RPS Goals
  - Consumer interest
## SAMPLE IRP RESULTS #1

<table>
<thead>
<tr>
<th>Scenario</th>
<th>NPV ($Millions)</th>
<th>Rate ($/MWh)</th>
<th>NPV ($Millions)</th>
<th>Rate ($/MWh)</th>
<th>NPV ($Millions)</th>
<th>Rate ($/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Business As Usual (BAU)</td>
<td>$455.7</td>
<td>$34.83</td>
<td>$596.3</td>
<td>$50.50</td>
<td>$591.3</td>
<td>$49.31</td>
</tr>
<tr>
<td>2. Scenario 1 - Block PPAs</td>
<td>$657.2</td>
<td>$50.23</td>
<td>$753.8</td>
<td>$63.84</td>
<td>$727.0</td>
<td>$60.63</td>
</tr>
<tr>
<td>3. Scenario 2 - RICE / LM2500, Block PPA</td>
<td>$686.4</td>
<td>$52.46</td>
<td>$771.4</td>
<td>$65.33</td>
<td>$769.8</td>
<td>$64.20</td>
</tr>
<tr>
<td>4. Scenario 3 - LM2500, Block PPA, Wind</td>
<td>$381.4</td>
<td>$29.16</td>
<td>$503.7</td>
<td>$42.66</td>
<td>$618.3</td>
<td>$51.57</td>
</tr>
<tr>
<td>5. Scenario 4 - LM2500, Block PPA, Solar</td>
<td>$458.1</td>
<td>$35.01</td>
<td>$578.7</td>
<td>$49.01</td>
<td>$672.2</td>
<td>$56.06</td>
</tr>
<tr>
<td>6. Scenario 5 - LM6000, Wind PPA</td>
<td>$414.3</td>
<td>$31.67</td>
<td>$615.3</td>
<td>$52.11</td>
<td>$609.7</td>
<td>$50.84</td>
</tr>
<tr>
<td>7. Scenario 6 - RICE, Wind PPA</td>
<td>$369.7</td>
<td>$28.26</td>
<td>$547.0</td>
<td>$46.33</td>
<td>$693.0</td>
<td>$57.79</td>
</tr>
<tr>
<td>8. Scenario 7 - RTO Market</td>
<td>$539.6</td>
<td>$41.24</td>
<td>$559.4</td>
<td>$47.37</td>
<td>$620.2</td>
<td>$51.72</td>
</tr>
<tr>
<td>9. Scenario 8 - Modular Nuclear</td>
<td>$473.8</td>
<td>$36.22</td>
<td>$551.1</td>
<td>$46.67</td>
<td>$543.5</td>
<td>$45.33</td>
</tr>
<tr>
<td>10. Scenario 9 - Modular Nuclear, Wind</td>
<td>$443.7</td>
<td>$33.91</td>
<td>$541.6</td>
<td>$45.87</td>
<td>$559.8</td>
<td>$46.69</td>
</tr>
<tr>
<td>11. Scenario 10 - Modular Nuclear, Block PPA</td>
<td>$614.8</td>
<td>$46.99</td>
<td>$693.3</td>
<td>$58.72</td>
<td>$695.7</td>
<td>$58.02</td>
</tr>
</tbody>
</table>

### Graph

- **Peak**
- **Inter.**
- **Base**
- **Load**
- **Market Purchase**
- **Renewables**
- **Distributed Generation**
- **On-Peak 5x16 Block**
- **Base 7x24 Block**
- **Nuclear**

---

*Image and text content is not fully legible due to low resolution and quality.*
### Feasibility Evaluation Summary

3.29% Financing Rate

#### $3 Gas Price Scenario

<table>
<thead>
<tr>
<th>MW/1</th>
<th>Capital Invest</th>
<th>20yr NPV</th>
<th>20yr NPV Mills</th>
<th>30yr NPV</th>
<th>30yr NPV Mills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M</td>
<td>$M</td>
<td>Mills</td>
<td>$M</td>
<td>Mills</td>
</tr>
<tr>
<td>1.</td>
<td>Self Build Alt. 1 + Self Build Alt. 5</td>
<td>405.0</td>
<td>$225.0</td>
<td>$905</td>
<td>63.2</td>
</tr>
<tr>
<td>2.</td>
<td>Supplier 20yr Full Req. (1/1/2025)</td>
<td>400.0</td>
<td>$0.0</td>
<td>$915</td>
<td>69.4</td>
</tr>
<tr>
<td>3.</td>
<td>Supplier 30Yr Full Req. (7/1/2025)</td>
<td>400.0</td>
<td>$0.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4.</td>
<td>Supplier 20Yr PPA + Self Build Alt. 3</td>
<td>403.5</td>
<td>$175.0</td>
<td>$925</td>
<td>72.1</td>
</tr>
</tbody>
</table>

#### $6 Gas Price Scenario

<table>
<thead>
<tr>
<th>MW/1</th>
<th>Capital Invest</th>
<th>20yr NPV</th>
<th>20yr NPV Mills</th>
<th>30yr NPV</th>
<th>30yr NPV Mills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M</td>
<td>$M</td>
<td>Mills</td>
<td>$M</td>
<td>Mills</td>
</tr>
<tr>
<td>1.</td>
<td>Self Build Alt. 1 + Self Build Alt. 5</td>
<td>405.0</td>
<td>$225.0</td>
<td>$985</td>
<td>82.8</td>
</tr>
<tr>
<td>2.</td>
<td>Supplier 20yr Full Req. (1/1/2025)</td>
<td>400.0</td>
<td>$0.0</td>
<td>$965</td>
<td>87.9</td>
</tr>
<tr>
<td>3.</td>
<td>Supplier 30Yr Full Req. (7/1/2025)</td>
<td>400.0</td>
<td>$0.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4.</td>
<td>Supplier 20Yr PPA + Self Build Alt. 3</td>
<td>403.5</td>
<td>$175.0</td>
<td>$975</td>
<td>83.7</td>
</tr>
</tbody>
</table>